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ROYAL ASTRONOMICAL SOCIETY.

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G. B. Airy, Esq., President, in the Chair.

Follett Osler, Esq., Hazelwood, near Birmingham, and the
Rev. Stephen Parkinson, St. John's College, Cambridge,

were balloted for and duly elected Fellows of the Society.

Letter from Mr. Lassell to the Rev. R. Sheepshanks.

"I have now to trouble you with the results of my observations upon *Uranus* and his satellites, which have now got too much into the twilight for further observation. In another mail or two I may probably send you a summary of my observations upon *Saturn*, with some more diagrams, recording in detail some of his delicate phenomena, with the dates in order of time. It will include also a series of observations of *Hyperion* and some measures of the diameters of the planet and major axis of his ring. From its voluminous appearance, however, amounting to three or four sheets, I feel some diffidence about sending it off, though I cannot but persuade myself that it may be an interesting record to refer to, of the appearance of an object which is unique and of such surpassing interest.

"I will mention *en passant* a phenomenon of the obscure ring which I have only lately noticed, and which I fear cannot much longer be observed during this apparition: indeed, the sky during the last month, and thus far in the present one, has yielded me only a small fraction of the fine nights I have been used to enjoy in the same period here. The obscure ring appears to me to vary in colour, one end of it being often bluish-gray, while the other is brown. For instance,

Dec. 28	preceding end	bluish-gray	following	brown
Jan. 6	— —	gray	—	brown
12	— —	brown	—	gray
25	south preceding	gray	north following	brown
28	— —	brown	— —	gray
Feb. 3	north preceding	brown	south following	gray

" The sky has not permitted me to pursue this very delicate observation so as to arrive at any conclusion about the rotation of the ring; but there is no question about the fact of a difference of colour being sometimes observable.

" I am now beginning to look towards the time of my departure, which I fancy will be about the middle of next month. I don't think we shall leave the island without some regrets for the loss of its splendid skies and marine views, and also for the loss of the agreeable society we have enjoyed here.

" *Observations of the Satellites of Uranus made with the 20-foot Equatoreal at Valetta.*

	Ariel.				Umbriel.			
	Position.		Distance.		Position.		Distance.	
	G.M.T.							
1852.	h m	° ′	h m	″	h m	° ′	h m	″
Oct. 15	...	310 0	10 0	10	...	294 0	...	14
16	...	138 0	...	...	...	175 0	...	...
18	11 30	210 0	11 30	...	11 30	12 0	...	..
29	9 0	...	...	...	...	...	...	..
30	9 24	330 40	...	15	9 45	58 59	...	18
31	...	190 0	...	14	...	350 0	...	18½
Nov. 1	...	130 0	...	...	...	5 0	...	...
3	...	113 0	...	10	...	89 0	...	14
4	9 47	331 34	10 21	12·03	9 39	352 35	10 8	20·70
6	9 26	32 48	...	...	9 36	173 35	...	...
10	9 23	188 40	...	11½	9 23	186 40	...	19¾
11	...	44 0	...	...	...	99 0	...	...
12	...	265 0	...	...	...	20 0	...	...
15	9 0	190 56	...	13	0	...	...	19
16	...	52 0	...	...	...	22 0	...	...
18	...	135 0	...	13¾	...	211 0	...	16½
19	...	344 0	...	...	...	146 0	...	...
20	9 10	193 38	...	13¾	8 59	38 44	...	21
Dec. 6	...	93 0	...	...	...	...	...	...
7	...	300 0	...	...	...	...	...	...
8	...	283 0	...	...	...	173 0	...	...
9	8 9	3 58	8 54	13·64	8 28	186 41	9 12	17·43
13	8 14	164 58	8 27	13·18	8 20	203 24	8 38	17·12
1853.								
Jan. 7	...	...	5 57	13·58	...	...	5 46	15·96
11	6 5	348 22	...	...	6 11	210 0	...	...

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	Titania.				Oberon.			
	Position.		Distance.		Position.		Distance.	
	G.M.T.							
1852.	h m	° ′	h m	″	h m	° ′	h m	″
Oct. 15	...	168 46	...	30·38	...	332 15	...	40·86
16	10 18	131 55	10 38	27·91	10 10	305 17	10 30	37·85
18	11 41	34 32	12 1	28·76	11 34	239 0	11 50	34·90
29	9 18	317 35	9 37	28·46	9 10	321 52	9 24	40·48
30	10 7	265 8	10 28	25·17	9 56	289 10	10 21	36·19
31	9 50	218 27	10 14	27·39	9 41	256 26	10 1	33·24
Nov. 1	9 50	182 54	10 9	32·44	9 43	224 39	9 59	37·93
2	12 17	146 25	12 32	29·95	12 12	206 40	12 24	42·36
3	9 12	108 46	9 38	25·48	9 2	178 26	9 26	43·19
4	9 29	57 58	10 35	25·62	9 18	157 19	10 30	42·84
5	8 46	17 5	9 3	30·33	8 38	134 48	8 55	38·29
6	9 14	342 14	10 10	31·56	9 6	104 43	9 47	33·58
10	9 11	172 7	9 47	33·08	9 1	353 50	9 31	43·79
11	9 31	138 39	9 50	28·71	9 25	330 23	9 40	42·21
12	8 51	93 51	9 15	25·13	8 43	306 19	9 3	37·94
15	8 51	332 29	9 29	31·19	8 42	211 50	9 15	38·33
16	9 0	291 47	9 30	25·83	8 46	187 26	9 11	43·57
18	9 2	195 45	9 24	30·02	9 3	145 10	9 13	41·43
19	8 51	163 45	9 20	32·17	8 42	118 59	9 4	36·23
20	8 47	129 19	9 30	27·47	8 36	88 20	9 22	34·05
Dec. 6	8 5	178 17	8 28	32·15	7 54	14 22	8 37	41·58
7	8 22	144 29	8 51	30·37	8 13	350 37	8 36	43·68
8	8 36	102 48	8 53	24·95	8 24	328 54	8 42	41·26
9	8 38	50 2	...	...	8 37	304 2	...	...
13	9 0	245 21	8 50	24·54	8 57	184 14	8 43	42·02
1853. Jan. 7	6 40	306 43	6 28	27·74	6 30	238 8	...	...

"*Remarks.*

"Oct. 15. Being the first occasion on which I measured the satellites here, I was greatly struck with their brightness, even the close ones scarce required looking for, and all were well seen with the planet full in the field. *Oberon* the brightest; *Titania* slightly inferior; *Ariel* much brighter than *Umbriel*, which is rather less favourably situated.

"Oct. 16. The planet appearing as a bright sixth-magnitude star, and easily recognisable, I set the telescope upon him for the first time by the naked eye, without using the circles. The close satellites fainter than yesterday.

"Oct. 18. *Titania* decidedly brighter than *Oberon*. Measures of distance taken with difficulty, the sky being variable and often slightly clouded.

"Oct. 29. Only one of the close satellites seen. The nearly full moon within one hour and a quarter of the planet, and more north in declination, puts out the small satellites and renders it not very easy to observe the bright ones.

"Oct. 30. No measures of distance of the faint satellites could be got, the measures of position being, indeed, difficult in the bright moonlight distance of *Ariel*, estimated at six-tenths of the distance of *Titania;* distance of *Ariel* estimated to that of *Umbriel* as five to six.

"Nov. 2. Troubled by thin clouds, which interrupted the observations and prevented more than three measures of each being taken. Close satellites not seen.

" Nov. 4. Atmosphere unusually fine. All the satellites, even the faint ones, measured in position and distance with remarkable ease. *Titania* rather brighter than *Oberon;* measuring power on the micrometer 760, though the satellites were brightest and, on the whole, best seen, with 1018 negative eye-piece. Under these favourable circumstances, I surveyed the planet round to the distance of 2½′ without finding any points of light which might be satellites. Even the faint satellites with this power are bright objects, and not for a moment to be overlooked. The disk of the planet harder and sharper than I have ever seen it before. With 1917 the faint satellites are, I think, even more obvious.

" Nov. 5. *Titania* brighter than *Oberon*, and, therefore, easier to measure. The close satellites not well seen to-night.

" Nov. 6. Interior satellites too faint for measurement in distance.

" Nov. 10. The close satellites in a line with the centre of the planet at $8^h\ 30^m$ G.M.T. *Ariel* three-tenths and a half of the distance of *Titania; Umbriel* six-tenths of the same distance from the planet. Both too faint for measures of distance. *Oberon* brighter than *Titania.*

" Nov. 12. Air unfavourable. Measures taken with much difficulty.

" Nov. 15. Wind troublesome, setting right in the opening of the roof; and the close satellites, though plainly seen with 1018, could not be satisfactorily measured in distance. *Ariel* very much brighter than *Umbriel.* Distance of *Ariel* estimated one-third that of *Oberon. Umbriel* about half the distance of *Oberon.* No other stars visible within 3′½ of the planet, with power 1018 (except some which were *ascertained* to be stars).

" Nov. 16. *Umbriel* appears to-night brighter than *Ariel*, which is near its closest approach to the planet.

" Nov. 20. Satellites singularly placed, describing an almost perfect parallelogram.

" Nov. 22. The sky being unfit for measurements of the satellites, I measured the diameter of the planet. The mean of eight measures with the ordinary micrometer power of 760, gave $4''\cdot128$.

" Dec. 6. *Titania* in almost the best possible position for measures of distance; and, accordingly, the extreme difference of six measures amounts only to $0''\cdot39$. *Umbriel* not seen.

" Dec. 7. Interrupted by clouds; and though the faint satellites had been so bright as to be easily discovered by a non-astronomical friend, who happened to be present, and who had no knowledge of their places, no measures of them were obtained.

" Dec. 8. The disk of the planet very well defined and sharp with 1018; but no ellipticity nor any markings upon his surface can be observed.

" Dec. 9. Obtained measures in position and distance of the close satellites with power 760. Also measured diameter of planet with the same power; the mean of eight measures gave $4''\cdot097$.

" Dec. 13. Measured the four satellites in position and distance with 760. *Oberon* considerably brighter than *Titania.* By hiding the planet behind one of the bars of the micrometer, all four satellites were visible at once with 297, the inner ones with surprising brightness, taking into account their extreme proximity to the planet with that power. They instantly vanished when the planet was exposed. The satellites being favourably situated, this experiment was made to ascertain with how small a power they could be seen; and I think this is about the minimum for the close ones.

" Dec. 20. In a very fine sky I was struck with the beauty of the disk of *Uranus* with 297. In scrutinising his surface I frequently suspected a spot near his centre, but could not in the end be certain whether it was real or an optical illusion. Surveyed the planet with 565, with which the bright satellites were instantly seen, notwithstanding the very close neighbourhood of the moon and a rather hazy sky. The field was, however, so full of light, that it would have been in vain to look for the faint ones. The edge of the disk was as hard and sharp with this power as I have often seen the edge of *Jupiter* with a fine refractor of three or four inches' aperture. It was so fine that I applied a power of 778, which it bore admirably; but I could not verify the suspected spot nor

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satisfy myself that any phenomena were visible upon his surface; nor that there was any sensible ellipticity of form. I seized the opportunity of measuring his disk; power 760. The mean of eight measures gave 4″·466.

" Dec. 22. The mean of eight measures of the planet's diameter with power 1027 gave 3″·945. Sky rather less favourable than usual.

" Dec. 27. The mean of nine measures of the disk with 760 gave 4″·032.

" 1853, Jan. 7. All the satellites well seen with 565, and still better with 1018, which, under good atmospherical circumstances, I generally find the most efficient power for such scrutiny. During this series of observations, though I have very commonly seen small fixed stars in the field with the satellites, I have never seen any which, by magnitude and position, could ever be mistaken for them. I find this peculiarity attend the close satellites, that they do not bear illumination well, and, therefore, cannot be ordinarily seen when the moon is near enough sensibly to brighten the sky. Though very conspicuous objects in the large dark field of a negative eye-piece, the faintest illumination greatly reduces their brightness; and to measure them micrometrically is almost always a work of labour and difficulty.

" Jan. 11. Surveyed *Uranus* with 1018 under a fine sky and admirable definition, the disk appearing perfectly round, and having a remarkably hard and sharp edge. On this occasion, as well as many others which I have not thought it necessary to particularise, I carefully scrutinised the neighbourhood of the planet to the distance of 5′ from his centre, for the discovery of other satellites. In the course of this scrutiny I made many measurements and diagrams of the positions of small points of light, which all turned out to be stars; and I cannot now resist the conviction, amounting, indeed, in my own mind to certainty, that *Uranus* has no other satellites visible with my eye and optical means. In other words, *I am fully persuaded that either he has no other satellites than these four, or if he has, they remain yet to be discovered.*

" The most probable periods of the newly discovered satellites which I have been able to deduce from this series of observations, combined with that of 1851, and the single observation of Nov. 6th, 1847, are, for *Ariel* 2·520378 days, or 2^{d} 12^{h} 29^{m} 20^{s}·66, and for *Umbriel* 4·144537 days, or 4^{d} 3^{h} 28^{m} 8^{s}·00. The period of *Umbriel* is almost identically the same as that given in the *Monthly Notice* for March last, page 154, from the observations of 1851; and the difference in that of *Ariel* admits of easy explanation. Owing to the shortness of the period of this satellite, and my being only able to get *estimations* of the position-angles in 1851, and further, having no certain observation to serve as an epoch later than 1847, I could not, from the observations of 1851 alone, ascertain the period so exactly as to be *sure* of the *number* of revolutions elapsing in those four years. In my determination of the period last year I concluded that, in the interval between 1847, Nov. 6·429, and 1851, Nov. 2·500, 580·114 revolutions had occurred, which gave a period of 2·511700 days. It now appears that only 578·114 revolutions could have taken place in that interval, giving a period of 2·520388 days, extremely near to that which satisfies best all the observations.

" WM. LASSELL.

" *Valetta, 8th Feb.* 1853."